Suomi NPP Algorithm Maturity and Validation Status

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Introduction

Data from the JPSS satellite suite are processed into sensor and environmental data records (SDRs and EDRs) that are disseminated to the customer and user community for integration into a multitude of applications, including forecasting, military applications, and climate studies.

To ensure quality of the JPSS data products, the JPSS Ground Project has established a Calibration/Validation Program consisting of multiple discipline teams led by community experts that have extensive knowledge of the sensors, extensive subject matter expertise, and heritage experience with space-based environmental measurements. Documented Suomi NPP Cal/Val Plans explain the detailed activities planned for the assessment, improvement, and validation of the Suomi NPP SDRs and EDRs.

The Suomi NPP Data Product Maturity definitions (Tables 2 and 3) are based on heritage NASA Earth Observing System (EOS) classifications, in order to support consistency and continuity with the EOS mission. Additionally, the JPSS definitions include conditions to meet product requirements. Each SDR (Level 1 equivalent), EDR (Level 2 equivalent), and intermediate product is individually assessed for maturity, as discipline team leads define the specific exit criteria and translate the general definitions in Table 1 to specific definitions for each product. The JPSS Program maintains an Algorithm Maturity Matrix (AMM) which defines the actual or projected dates that each of the data products has reached or will reach the various levels of maturity. Note that these dates reflect when the necessary algorithm modifications that will result in generation of the beta, provisional, or validated products have been identified; implementation of these changes into the operational system may be delayed anywhere from 1 week to several months depending on the complexity of the necessary changes. Inter-algorithm dependencies are also tracked with the AMM tool to ensure consistency between maturity advancement schedules and quick assessment of impacts of delays in validation efforts.

Upon implementation of the necessary algorithm modifications for 'beta' level maturity, each of the Suomi NPP data products, are made available to the community from the NOAA Comprehensive Large Array-data Stewardship System (CLASS). Members of the scientific community are encouraged to obtain these data from the archive and participate in the JPSS validation efforts as they progress to the provisional and validated maturity levels. Table 1 lists the actual and projected S-NPP algorithm maturity dates and the primary points of contact for the Calibration/Validation efforts associated with each of the S-NPP data products.

Algorithm Maturity Status and Schedule

Sensor	Algorithm	Beta	Provisional	Val 1	Val 2	Val 3	AD&Cal/Val POC
ATMS	SDR - Cal & Geo	12-Feb	13-Jan	13-Dec			Fuzhong Weng Edward Kim
OMPS	SDR - Ozone TC EV	12-Mar	13-Jan	13-Dec			Fred Wu Glen Jaross
OMPS	SDR - Ozone NP EV	12-Mar	13-Jan	13-Dec			Fred Wu Glen Jaross
OMPS	SDR - Ozone TC Geo	13-Mar	13-Jun	13-Aug			Fred Wu Glen Jaross
OMPS	SDR - Ozone NP Geo	12-Mar	13-Jan	13-Dec			Fred Wu Glen Jaross
VIIRS	SDR - Cal	12-Apr	13-Jan	13-Dec			Changyong Cao Frank DeLuccia
VIIRS	SDR - Geo	12-Apr	13-Jan	13-Dec			Changyong Cao Frank DeLuccia
VIIRS	Cloud Mask	12-Apr	13-Jan	13-Dec	14-Jun	14-Mar	Andrew Heidinger Thomas Kopp
CrIS	SDR - Cal&Geo	12-Apr	12-Oct	13-Jan			Yong Han
VIIRS	Imagery (Not NCC)	12-May	13-Jan	14-Jan	14-Jan	14-Jan	Don Hillger
VIIRS	NCC Imagery	12-Dec	13-Jul	14-Jan	14-Jan	14-Jan	Don Hillger
VIIRS	Aerosols (AOT & SM)	12-Sept	13-May	14-May	14-Nov	15-Nov	Shobha Kondragunta Istvan Laszlo
VIIRS	Aerosol Particle Size	12-Sept	13-May	14-May	14-Nov	15-Nov	Shobha Kondragunta Istvan Laszlo
VIIRS	Land Active Fires	12-Oct	13-Aug	14-Sep	15-Sep	15-Dec	Ivan Csiszar
VIIRS	Surface Temps - LST	12-Dec	13-May	13-Dec	14-May	15-May	Bob Yu Jeff Privette
CrIMSS	EDR - AVTP, AVMP & AVPP	12-Jul	13-Mar	13-Dec	14-Dec	15-Dec	Chris Barnet
OMPS	EDR - First Guess IP	12-Jul	12-Dec	13-Jul	13-Sep	14-Feb	Larry Flynn
OMPS	EDR - Ozone TC	12-Jul	12-Dec	13-Jul	13-Sep	14-Feb	Larry Flynn
OMPS	EDR(IP) - Ozone NP	12-Jul	12-Dec	13-Jul	13-Sep	14-Feb	Larry Flynn
VIIRS	Surface Temps - SST	12-Dec	13-Sep	14-Mar	14-Sep	15-Mar	Sasha Ignatov
VIIRS	Land Veg Index	12-Dec	13-Sep	14-Jun	15-Jan	16-Jan	Marco Vargas Tomoaki Miura
VIIRS	Land Surface Reflectance IP	12-Dec	13-Jul	14-Jul	15-Jan	16-Jan	Eric Vermote Alexei Lyapustin
VIIRS	Ocean OCC / ACO	13-Jan	13-Jul	14-Jul	15-Jan	16-Jan	Menghua Wang Robert Arnone
VIIRS	Land Surf Type	12-Dec	13-Dec	14-Sep	15-Sep	15-Dec	Jerry Zhan Mark Friedl
VIIRS	Cloud COP	13-Mar	14-Jan	TBD	TBD	TBD	Andrew Heidinger
VIIRS	Cloud CTP (CTH, CTT, CTP)	13-Mar	14-Jan	14-May	14-Nov	15-Nov	Andrew Heidinger
VIIRS	Cloud CBH	13-Mar	14-Jan	14-May	14-Nov	15-Nov	Andrew Heidinger
VIIRS	Cloud CCL, PPC & GCE	13-Mar	14-Jan	14-May	14-Nov	15-Nov	Andrew Heidinger
VIIRS	Sea Ice Albedo & Combined Surface Albedo	13-Jun	13-Dec	14-Jun	14-Dec	15-Dec	Jeff Key
VIIRS	Sea Ice Char - Conc	13-Apr	13-Oct	14-Jan	14-Aug	15-Jan	Jeff Key
VIIRS	Sea Ice Char - Age	13-Apr	13-Oct	14-Aug	14-Oct	15-Apr	Jeff Key
VIIRS	Snow Cover - Binary mask	13-Apr	13-Oct	14-Jan	14-Aug	15-Jan	Jeff Key
VIIRS	Snow Cover - Fraction	13-Apr	13-Oct	14-Aug	14-Aug	15-Jan	Jeff Key
VIIRS	Surface Temps - IST	13-Mar	13-Sep	13-Dec	14-Mar	14-Sep	Jeff Key
OMPS	SDR Ozone TC Cal	13-Mar	13-Jun	13-Aug			Fred Wu
OMPS	SDR Ozone NP Cal	13-Mar	13-Jun	13-Aug			Fred Wu
VIIRS	Land Surface Albedo	13-May	13-Nov	14-Jul	15-Jan	16-Jan	Bob Yu Crystal Schaaf

Table 1: Actual (Green font) or projected (red font) maturity dates for the Suomi NPP data products and Suomi NPP Cal/Val points of contact. Dates indicate when the necessary algorithm modifications that will result in generation of the beta, provisional, or validated products have been identified; implementation of these changes into the operational system may be delayed anywhere from one week to several months depending on the complexity of the necessary changes.

S-NPP Beta maturity products and Data Quality Description Documents are available from the CLASS website at:

www.class.noaa.gov

S-NPP EDR Algorithm Maturity Definitions

Beta
- Early release product
- Minimally validated
- May still contain significant errors
- Available from CLASS to allow users to gain familiarity with data formats and parameters
- Product is not appropriate as the basis for quantitative scientific publications, studies, and applications

Provisional
- Product quality may not be optimal
- Incremental product improvements are still occurring
- General research community is encouraged to participate in the QA and validation of the product, but need to be aware that product validation and QA are ongoing
- Users are urged to consult the EDR product status document prior to use of the data in publications
- May be replaced in the archive when the validated product becomes available

Validated
- Product performance is well defined over a range of representative conditions
- Further improvements to the product may be made
- Product is specified as Stage 1, Stage 2, or Stage 3 Validated

Stage 1: Product performance has been demonstrated to comply with the specifications using a small number of independent measurements obtained from selected locations and periods

Stage 2: Product performance has been demonstrated to comply with the specifications over a widely distributed set of locations and periods

Stage 3: Product performance has been demonstrated to comply with the specifications and product uncertainties are established via independent measurements in a systematic and statistically robust way representing global conditions

S-NPP SDR Algorithm Maturity Definitions

Beta
- Early release product
- Initial calibration applied
- Minimally validated and may still contain significant errors
- Frequent changes to the product can be expected
- Available from CLASS to allow users to gain familiarity with data formats and parameters
- Product is not appropriate as the basis for quantitative scientific publications, studies, and applications

Provisional
- Product quality may not be optimal
- Incremental product improvements are still occurring as calibration parameters are adjusted with sensor on-orbit characterization
- General research community is encouraged to participate in the QA and validation of the product, but need to be aware that product validation and QA are ongoing
- Users are urged to consult the SDR product status document prior to use of the data in publications

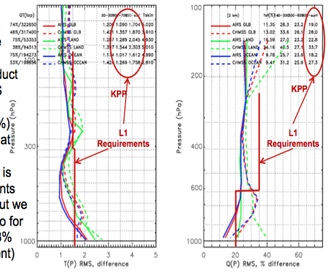
Validated/Calibrated
- On-orbit sensor performance is well-characterized and calibration parameters are adjusted accordingly
- Ready for use in applications and scientific publications
- Further improvements to the product may be made

EDR Performance

CrIMSS Products

Comparison of the IR+MW EDR w.r.t. ECMWF for May 15, 2012

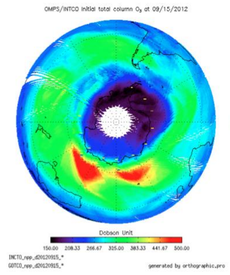
- Global (red), land (green) and ocean (blue) statistics are comparable with heritage AIRS product (solid), but CrIMSS EDR (dashed) has lower yield (38-53%) than AIRS (~75%) at this time
- KPP performance is close to requirements (1.6K) for AVTP, but we still have work to do for AVMP (global is 28% vs. 20% requirement)

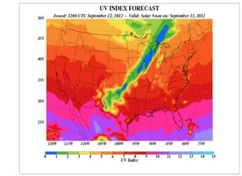


CRITICAL INFORMATION FOR NUMERICAL WEATHER FORECASTING

Ozone Products

The ozone team has been using OMPS data to track the Antarctic Ozone Hole.



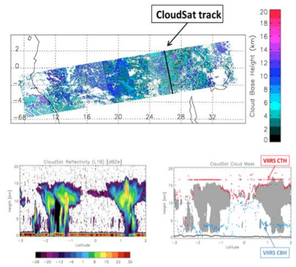


UV Index Forecast for September 13, 2012

<- False color map of total column ozone from the first guess OMPS product for September 15, 2012. Values below 220 Dobson Units are regarding as evidence of Ozone Hole conditions. The white region around the South Pole does not contain measurements as it is still within polar night. (Image courtesy Larry Flynn)

VIIRS Cloud Products

- Sample comparison of VIIRS cloud top and base heights with CloudSat cloud mask from 11:59:16 UTC to 12:00:40 UTC on 17 February 2012. (Top)
- VIIRS intermediate product cloud base height with CloudSat ground track overlaid. (Lower left)
- CloudSat reflectivity. (Lower right) CloudSat cloud mask with VIIRS IP cloud base heights (blue asterisks) and cloud top heights (red asterisks) overlaid.

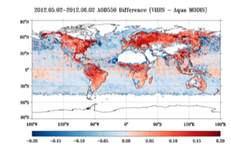


CRITICAL CLOUD INFORMATION FOR WEATHER AND AVIATION PPLICATIONS VERIFIED BY STATE-OF-THE ART METHODOLOGY

VIIRS Aerosol Products

- **VIIRS aerosol EDRs**
  - Aerosol Optical Thickness (AOT)
  - Aerosol Particle Size Parameter (APSP)
  - Suspended Matter (SM)
- **Aerosol EDR Assessment Basis to demonstrate "Beta Maturity" level:**
  - Data from May 2 to June 2, 2012
  - Qualitative and quantitative analysis of comparisons with other satellite (MODIS and CALIPSO) and ground-based (AERONET) aerosol data

Recommendation of VIIRS Aerosol Cal/Val Team
- **VIIRS aerosol EDRs at beta level**
  - AOT (land and ocean)
  - APSP (land and ocean)
- **VIIRS aerosol EDRs NOT at beta level**
  - SM



Spatial patterns of mean difference between VIIRS and MODIS AOT showing VIIRS is biased high over land and biased low over ocean.

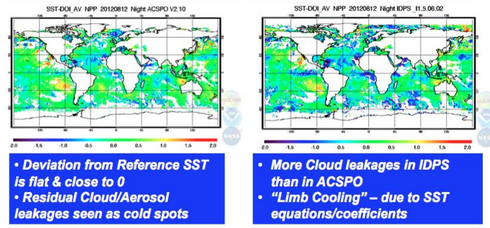
Error bounds for AOT defined by one standard deviation (68% of Retrievals)

	Land	Ocean
AERONET	±0.13 ± 15%	±0.04 ± 5%
MODIS	±0.09 ± 10%	±0.02 ± 10%

Significance: Preparing users for VIIRS aerosol products by conducting preliminary validation and showing what products are at beta maturity level.

VIIRS Sea Surface Temperature Product

	NOBS (%ACSPO)	Min/ Max	Mean/ STD	Med/ RSD	Skew/ Kurt
ACSPO	91.7M (100%)	-5.5/ +6.4	+0.08/0.51	+0.04/0.46	+0.4/ +1.8
IDPS	111.9M (122%)	-20.0/+23.1	-0.11/0.97	-0.08/0.47	-1.3/+41.9

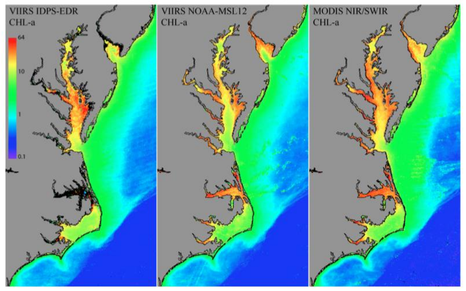


- *Deviation from Reference SST is flat & close to 0*
- *Residual Cloud/Aerosol leakages seen as cold spots*
- *More Cloud leakages in IDPS than in ACSPO*
- *"Limb Cooling" – due to SST equations/coefficients*

VIIRS Ocean Color Product

Results Consistent with MODIS-Aqua

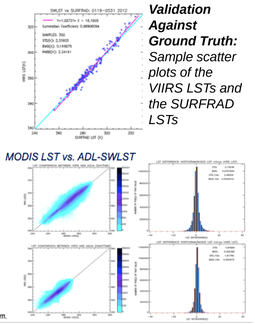
Composite images (Feb.6–Mar.12, 2012) in US East Coast



VIIRS LST Product

Current Status:

- VIIRS LST values are close to the MODIS LSTs over surface types of deciduous broadleaf forests and Croplands/Natural Vegetation Mosaics, but have significant difference over permanent wetlands, barren, water bodies, evergreen needle leaf forests and closed shrub lands.
- LST values on Inland Water is high.
- Due to snow flag error, nighttime LST on snow surface may be incorrect.

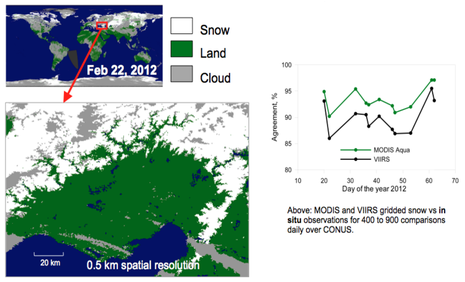


Validation Against Ground Truth: *Sample scatter plots of the VIIRS LSTs and the SURFRAD LSTs*

Slide courtesy of Bob Yu, Jeff Privette, Pierre Guillevic, and the LST Team.

VIIRS Cryosphere Products

Global gridded VIIRS snow map: **Realistic, detailed** characterization of regional snow cover at high spatial resolution. However, VIIRS sees less snow than MODIS, and has some false snow in tropical areas.



Above: MODIS and VIIRS gridded snow vs in situ observations for 400 to 900 comparisons daily over CONUS.

AMS 2013